WETLAND ASSESSMENT: PROPOSED WATER USE LICENSE APPLICATION FOR COROBRIK LAWLEY, IN JOHANNESBURG METROPOLITAN MUNICIPALITY, GAUTENG

Document Control

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Executive Summary

MORA Ecological Services (Pty) Ltd was appointed by Corobrik Lawley Operation to conduct a wetland impact assessment. The aquatic ecology information from the desktop study and that which was collected on site will be used to inform the Department of Water and Sanitation during the water use license application adjudication.

A site visit was conducted on the 09th of February 2024, by a team of ecologists and the purpose of the site visit was to collect data. The team investigated the presence of aquatic systems around the proposed project area.

The site falls within Quaternary Catchment C22A and is located in the Upper Vaal Water Management Area. The assessment aims to identify and determine the natural importance and the current status of the wetlands in the study area. The survey also looked at other available aquatic features that will assist in determining the impacts caused by the current activities. Mora Ecological Services will be guided by the findings of this study to suggest the appropriate recommendations in terms of mitigation measures that can be used to prevent or minimize further impact on the aquatic resources.

The site has several quarries that have been in existence for several years as a result of mining. These quarries were not properly rehabilitated, and as a result, they turned into artificial wetlands. The unchanneled-valley bottom wetland should be protected against any potential impacts related to the mining activities.

Declaration of Independence

I, Mokgatla Molepo, in my capacity as a specialist consultant, hereby declare that I:

- Act/acted as an independent specialist to Corobrik Lawley for this project.
- Do not have any personal, business, or financial interest in the project except for financial remuneration for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2014, as amended.
- Will not be affected by the outcome of the environmental process, of which this report forms part.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the proposed developments but aim to present facts and my best scientific and professional opinion about the impacts of the development.
- Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2014, as amended.

Indemnity

- This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
- This report is based on a desktop investigation using available information and data related to the site to be affected, *in situ* fieldwork, surveys, and assessments, and the specialist's best scientific and professional knowledge.
- The Precautionary Principle has been applied throughout this investigation.
- The findings, results, observations, conclusions, and recommendations given in this report are based on the specialist's best scientific and professional knowledge as well as information available at the time of the study.
- Additional information may become known or available later in the process for which no allowance could have been made at the time of this report.
- The specialist reserves the right to modify this report, recommendations, and conclusions at any stage should additional information become available.
- Information and recommendations in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Mokgatla Molepo *Pr. Nat. Sci.* (009509)

26 February 2024

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Introduction

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The scope of work for the project:
The project aimed at:

- Assessing the wetlands in the area;
- Delineate the extent of the buffer zone of the existing wetland and or rivers; and
- Document the findings and produce the report.

Study Area

The study area is located outside Lawley Town in the Johannesburg Metropolitan Municipality in Gauteng province.

Climate

The climate in this region is mild, and generally warm and temperate. In winter, there is much less rainfall than in summer. According to Köppen and Geiger, this climate is classified as Cwb. The average annual temperature is 15.9 °C. Mean Annual Rainfall is 784 mm.

Vegetation

The majority of the study area falls within Carletonville Dolomite Grassland, with the remaining portions falling under Soweto Highveld Grassland.

Conservation Status

According to the 2021 List of Threatened Ecosystems, Carletonville Dolomite Grassland is not threatened, and Soweto Highveld Grassland is Vulnerable.

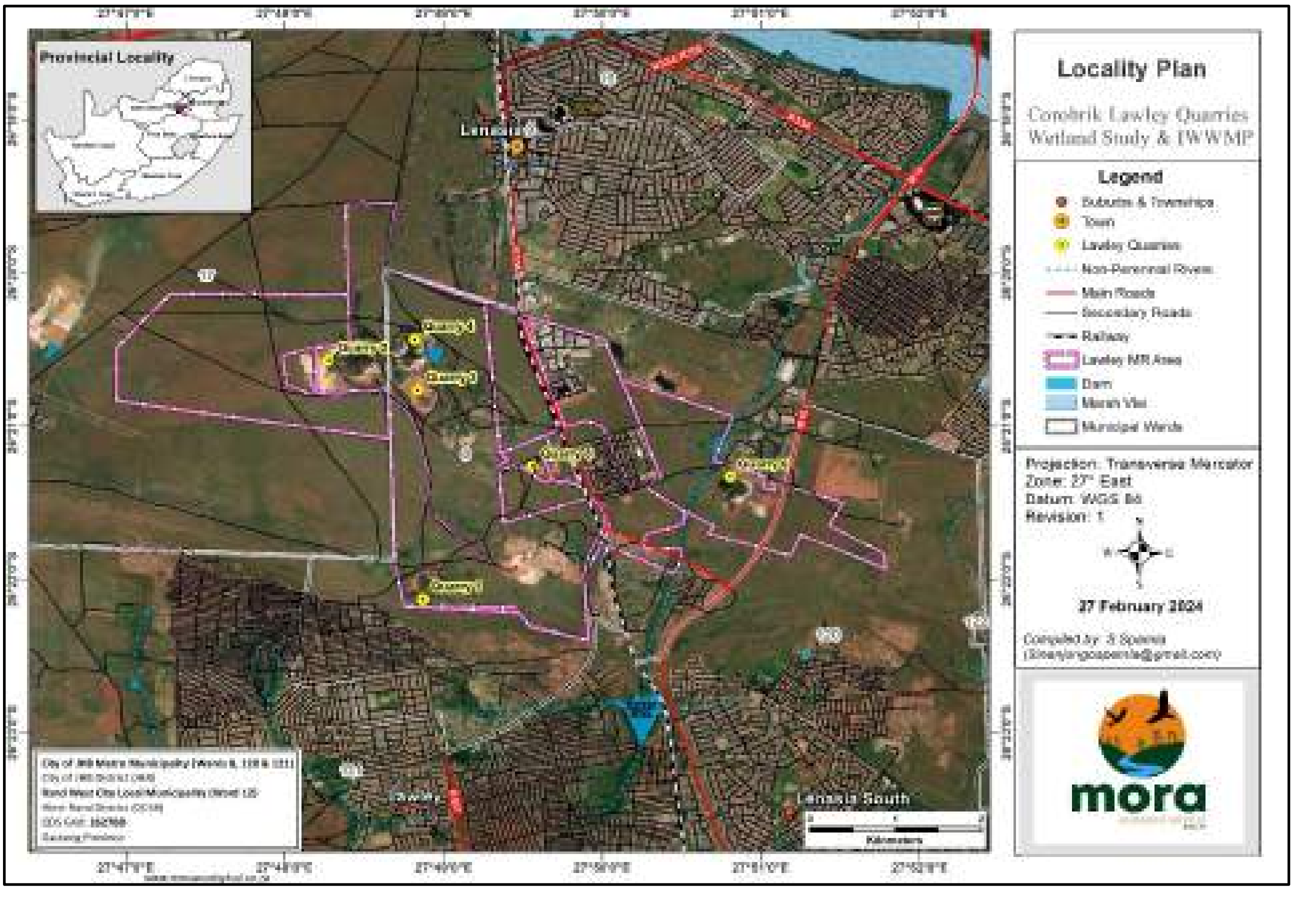

Figure 1: Locality of the study site.

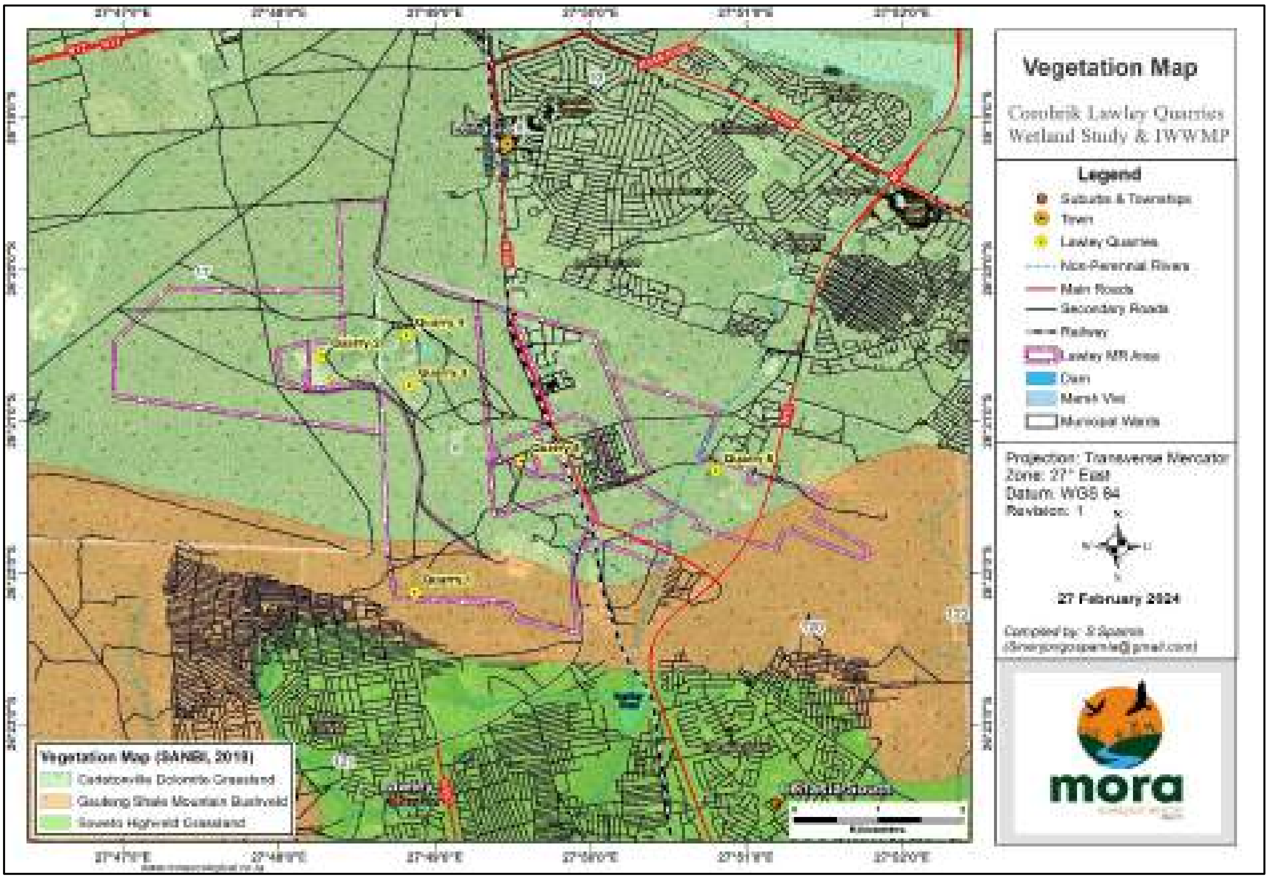

Figure 2: Vegetation types on the study area.

What is a Wetland

Wetlands are described as a unique place on earth that is transitional between aquatic and terrestrial ecosystems, has its water table close to or above the soil surface, is characterized by (unique) saturated soil and hydrophytic vegetation types, and accommodating distinctive organisms (Edwards, *et al*., 2018). In terms of Section 1 of the National Water Act (NWA, Act 36 of 1998), wetlands are legally defined as "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*."

Wetlands are the results of an anaerobic process (i.e. without air–oxygen) in the soil (hydric) which favors and support specific and unique vegetation (hydrophytes) and perhaps attracts unique fauna/animals (Edwards, *et al*., 2018). The hydric soil of the wetland is distinctive and characterised by redoximorphic and/or gleying conditions.

Wetlands are biologically diverse and productive unique ecosystems (Cherry, 2011) and experience huge pressure. These are unique lands or areas on earth which occur in areas where the groundwater discharges to the surface forming seeps and Lawley. Wetlands are vitally important in that they provide several benefits to biodiversity and human life, directly and indirectly, (Kotze *et al*., 2005). Amongst the others are water purification, flood reduction, erosion control, socio-economic (e.g. birding), tourism, and education. Protecting and conserving these habitats are critical and mandated by several legislation and laws.

These habitats are found where the topography and geological parameters impede the flow of water through the catchment, resulting in the soil profiles of these habitats becoming temporarily, seasonally, or permanently wet.

There are up to seven different types of wetlands regarding their topography and geological features and differences, as per the WET-EcoServices technique. Some examples are; pan, valley channels, seepage, dams, etc., figure 2 and table 1.

The differentiation/classification of the wetlands in the study area into different wetland types was based on the WET-EcoServices technique (Kotze *et al,* 2005). These are all significant to nature and the environment. There is a need to assess and compare wetlands in terms of ecosystem service delivery to prioritize protection and restoration efforts, (Walters, *et al.,* 2021)

Over 50% of the South African wetlands are lost and under serious threat (Edwards, *et al.,* 2018). Due to the continuing habitat loss, wetlands, and biodiversity, in general, are experiencing demise. In the past 20 years, South Africa lost up to 60% of its biodiversity (Wright, *et al.,* 2018) through human-induced activities. In the past 30 years, South Africa's grassland transformed or changed by more than 50%, (Schoeman, 2013).

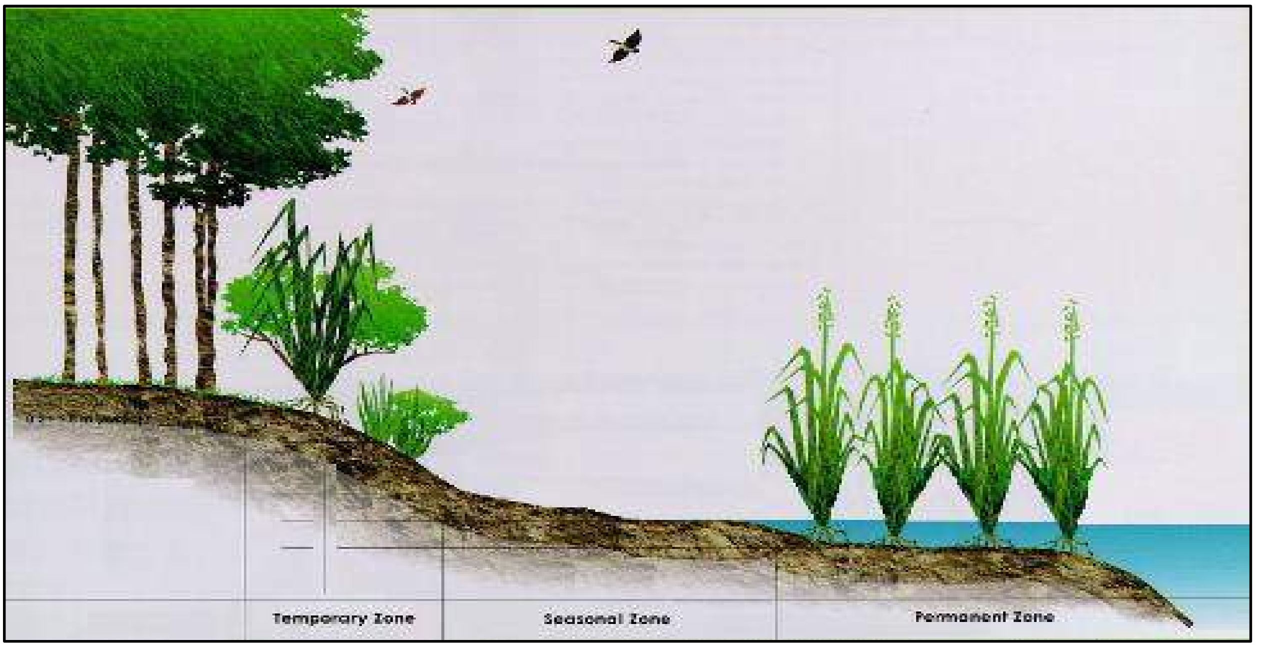

Figure 3: Wetland diagram showing the different zones.

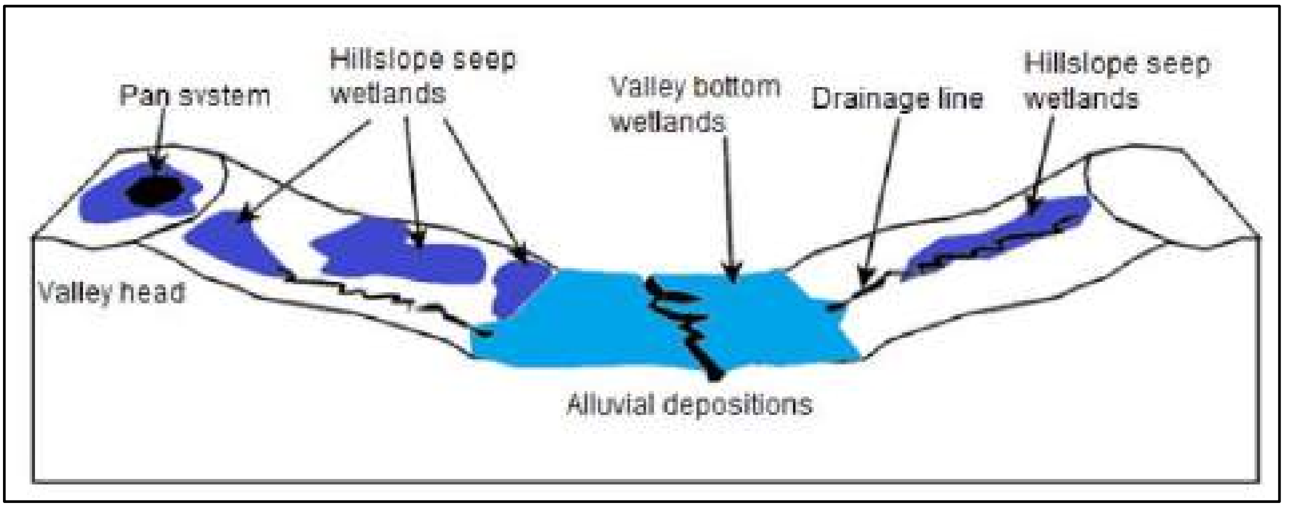

Figure 4: Wetland types as described by Kotze (2007) and Ollis (2013).

TABLE 1: DIFFERENT TYPES OF WETLANDS

Hydro-geomorphic types	**Description**	**Source of water maintaining the wetland[1]**	
		Surface	**Sub-surface**
Floodplain	Valley bottom areas with a well-defined stream channel, gently sloped & characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.	***	*

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Valley bottom with a channel	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel	Valley bottom areas with no clearly defined stream channel are usually gently sloped and characterized by alluvial sediment deposition, generally leading to the accumulation of sediment. Water inputs mainly from channels entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seep with stream channel	Slopes on hillsides are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated hillslope seepage	Slopes on hillsides are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes pans)	A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e., it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

Precipitation is an important water source and evapotranspiration is an important output.

Water source: * Contribution usually small

** Contribution usually large

*** Contribution may be small or important depending on local circumstances

Terms Of Reference

This report is produced to outline detailed information/findings on the wetland assessment undertaken in the study area. It is to give a full picture of the potential impacts and recommended mitigation measures for the proposed activities.

The terms of reference for this study were as follows:

- Identify and delineate wetlands within the study area,
- Identify and apply buffers to the outer edges of the wetlands,
- Assess current impacts and suggest mitigation measures for minimizing impacts on wetlands; and
- Produce a detailed finding report with maps.

Assumptions and Limitations

The following assumptions and limitations apply to this report:

- The wetland assessment is confined to a 50m buffer of the project boundary; and;
- The wetland delineation as presented in this report is regarded as the best estimate of the wetland boundary based on the site conditions present at the time of assessment. Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur.
- Identification of wetlands is guided by National Wetland Map 5 (NWM5) of National Biodiversity Assessment 2018 of SANBI.

Relevant Legislation

The Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996) – Section 24.

The Constitution is South Africa's overarching law. It prescribes minimum standards with which existing and new laws must comply. Chapter 2 of the Constitution contains the Bill of Rights in which basic human rights are enshrined. The government's commitment to give effect to the environmental rights enshrined in the Constitution is evident from the enactment of various pieces of environmental legislation since 1996, including the NWA, the NEMA, etc.

National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended.

NEMA replaces a number of the provisions of the Environmental Conservation Act, of 1989 (Act No. 73 of 1989) (ECA). The Act provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance, and procedures for coordinating environmental functions. The principles enshrined in NEMA guide the interpretation, administration, and implementation of the Act about the protection and/ or management of the environment. These principles serve as a framework within which environmental management must be formulated. Section 2(4) specifies that "*sustainable development requires the consideration of all relevant factors including aspects specifically relevant to biodiversity*":

National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA).

NEMBA provides for the management and conservation of biological diversity and components thereof; the use of indigenous biological resources in a sustainable manner; the fair and equitable sharing of benefits arising from bio-prospecting of biological resources; and cooperative governance in biodiversity management and conservation within the framework of NEMA.

National Water Act, 1998 (Act No. 36 of 1998) (NWA).

The NWA is a legal framework for the effective and sustainable management of water resources in South Africa. Central to the NWA is the recognition that water is a scarce resource in the country which belongs to all the people of South Africa and needs to be managed sustainably to benefit all members of society. The NWA places a strong emphasis on the protection of water resources in South Africa, especially against its exploitation, and the insurance that there is water for social and economic development in the country for present and future generations.

The NWA requires any development to secure WUL's with the following activities:

Section 21 (c) and (i) use, i.e., river or wetland crossings, which includes any drainage lines by any infrastructure.

In terms of the definitions provided, activities included under Sections 21(c) and 21(i) are (amongst others) for the construction of roads, bridges, pipelines, culverts, and structures for slope stabilization and erosion protection. The Department of Water and Sanitation (DWS) will however need to be approached to guide on whether approval for Section 21 (c) and (i) water uses would be required.

General Authorisation in terms of section 39 of the NWA

According to the preamble to Part 6 of the NWA, "This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing General Authorizations in the Gazette.." "The use of water under a general authorization does not require a license until the general authorization is revoked, in which case licensing will be necessary…"

The General Authorisations for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks, or characteristics of a watercourse) as defined under the NWA have recently been revised (Government Notice R509 of 2016). Determining if a WUL is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorized in terms of General Authorisations (GA).

Protected Areas Act of 2003 (Act 57 of 2003)

The Protected Areas Act promotes the establishment and management of formally protected areas. The act protects the integrity of the ecology and safeguards nature and cultural resources, providing sustainable livelihoods and supports sustainable development.

Conservation of Agricultural Resources Act (Act 43 of 1983)

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilization of natural agricultural resources to promote the conservation of soil, water, and vegetation and provides for combating weeds and invasive plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under

Category 2 must be grown within a demarcated area under a permit. Category 3 includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

Local and provincial legislative tools are available and differ from one province to the other, which are all guided by national legislation.

Convention on the Conservation of Migratory Species (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic, and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned 22 with the conservation of wildlife and habitats on a global scale. Since the Convention entered into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe, and Oceania. South Africa is a signatory to this convention.

Government Notice 509 of 2016

Authorizations related to wetlands are regulated by Government Notice 509 of 2016 regarding Section 21(c) and (i). This notice grants General Authorisation (GA) for water-related uses under certain conditions such as that, all the water uses should be regulated and registered with the relevant authority. The Notice sets out the conditions and considerations which should be taken. For instance, the user of the water must ensure that the selection of a site for establishing any impeding or diverting the flow or altering the bed, banks, course, or characteristics of a watercourse works:

(i) is not located on a bend in the watercourse;

(ii) avoid high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps.

Other Relevant Legislations and Guidelines:

- DWS Wetlands Delineation and Riparian area determination Guideline, 2005;
- Biodiversity management plans (BMP); and
- National biodiversity assessment 2018 (NBA).
- National Wetland Management Framework for South Africa, 2021

Methodology

Literature Review and Desktop Assessment

Remote sensing of the area was undertaken. This was done to identify all the aquatic ecosystems and features on the site. Computer programs such as Google Earth Pro were used to access satellite imagery of the area to detect and study changes in land cover and other environmental features.

The South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (GIS) website as well as the latest Freshwater Ecosystem Priority Areas (FEPA) dataset were consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping.

A literature review of publications related and relevant to the study area was undertaken (see list of references). These were essential mainly during the identification of species, assessment guidelines, processes, and protocols on wetlands. Other resources visited and consulted include;

- SANBI Red List of South Africa Plants web: Threatened Species Programme | SANBI Red List of South African Plants (accessed on 05 January 2022) to attain the list of any red-lit plants in the area,
- Plants Of South Africa, of SANBI web: Home Page - BRAHMS Online (sanbi.org) (accessed on 05 January 2022) to attain any of the protected and endemic species,
- SANBI Institute's Biodiversity-GIS Map Viewer and database Biodiversity Data (sanbi.org) to access and view current aquatic systems from the study area,
- A cloud-based platform, Hub ArcGIS – Maps-wetlands, accessed at https://hub.arcgis.com/maps/edit?content=d1db45ea109b44828ba74a7bd941544b_20 to access and view the study area and analyse the current aquatic systems
- Intermediate Ecological Reserve PES method for [floodplain] wetlands (Duthie, 1999b)
- Guidelines for delineation of wetland boundaries and wetland zones (Marneweck and Kotze,1999): Part of the DWAF (1999c)

Desktop tools, programs, and applications such as Google Earth Pro (version 3) and Quantum Geographic Information Systems (QGIS 3.28.0) to view and compare the 3D satellite imagery of the study area to establish present and past events/situations of the terrain. During this assessment, the tools were used to determine and establish the 500m buffer from the borders of the study area/project site.

Recent and latest various national datasets accessed mainly from the SANBI database were used to screen and assess the study area remotely. The data extracted and used was mainly in a shapefile format for map production. Some of that data includes;

- National Wetland Management Framework For South Africa Report, 2021
- National; Terrestrial Threat Status and Protection level of 2018
- National Wetland Map 5 (NWM5) of National Biodiversity Assessment 2018

Data collection

A field assessment to delineate and assess the wetlands within the study area was undertaken on **09 February 2024**. Data collection involved the following:

- The recording of the dominant plant species and general composition of the wetland and riparian vegetation in the vicinity based on visual observations. Observations points were recorded onsite using a hand-held GPS.
- The recording of existing impacts using a hand-held GPS.

For the purposes of the infield assessment, all wetland occurring within 50m of the project activities were rated as having a likely and possible impact / risk potential and thus were investigated in the field, with the remaining areas of wetland within 500m mapped and assessed at a desktop level only.

Determining Buffer Zones

Tools for calculating buffer zones are available, such as the "Guideline for the Determination of Buffer Zones for Rivers, Wetlands, and Estuaries. Consolidated Report" by the WRC (Macfarlane & Bredin, 2017). This tool aims to calculate the best-suited buffer for each wetland or section of a wetland based on numerous on-site observations and the extent of the development's impact or risk to the ecosystem. Various buffer zones were developed and suggested to be applicable, see Table 2: Indicating the calculated buffer zones (Macfarlane *et al,* 2015). and Table 3: Stepwise tasks for buffer recommendation. below. It is also used to aid in watercourse classification and determining the need and extent of buffer zones. With other publications, this publication recognizes the following definition:

- **Buffer zone**: A strip of land with a use, function, or zoning specifically designed to protect one area of land against impacts from another.
- **Aquatic impact buffer zone**: A zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels.

According to this guideline, buffer widths should be tailored according to risk. This criterion recognizes the importance of using risk as a basis for establishing an appropriate buffer width. Where risk or uncertainty is high, ecologically conservative buffers should be established whereas less conservative buffers are appropriate for low-risk situations. Several key risk factors have been identified for possible inclusion in the approach. These are:

(i) Risks posed by adjacent land uses or activities;

(ii) The importance and sensitivity of the water resource;

(iii) The conservation status (risk of extinction) of aquatic and semi-aquatic species;

(iv) Characteristics of the buffer that affects the functionality of the buffer; and

(v) Mitigation measures that may be applied to reduce risks.

The extent of the buffer zone is calculated from the:

(i) Edge of the active channel (Rivers and streams);

(ii) Edge of the temporary zone (Wetlands).

This method of calculating the extent of the buffer is designed for site-based assessments and includes a more detailed evaluation of risks and consideration of site-specific factors that can affect the buffer requirements. Such an approach is designed to inform any detailed development planning and provide an appropriate level of information for authorization purposes. Table 3: Stepwise tasks for buffer recommendation. below, shows the stepwise methodology to be applied.

TABLE 2: INDICATING THE CALCULATED BUFFER ZONES (MACFARLANE ET AL, 2015).

Wetland	Construction Phase	Operational Phase
Seepage Wetlands	50 m	79 m
Depressional Pan Wetlands	42 m	80 m
Unchanneled Valley Bottom Wetlands	58 m	92 m
Channeled Valley Bottom Wetlands	62 m	98 m

TABLE 3: STEPWISE TASKS FOR BUFFER RECOMMENDATION.

Step	Task	Scope
1	Define objectives and scope to determine the most appropriate level of assessment	**Desktop assessment:** This assessment is designed to characterize risks at a desktop level to red-flag land located adjacent to water resources that should potentially be set aside and managed to limit impacts on water resources. **Site-based assessment:** This assessment is designed for site-based assessments and includes a more detailed evaluation of risks and consideration of site-specific factors that can affect buffer requirements.
2	Map and categorize water resources	The assessor is required to generate a map delineating the boundaries of the water resources potentially affected by proposed developments within the study area.
2.1	Classify the watercourse	E.g., Wetland, spring, or river, and subcategories: Ephemeral drainage line and type of channel (albeit with or without active channel).
2.2	Map the line from which aquatic impact buffer zones will be delineated. (Edge of the active channel)	• Rivers and streams – the outer edge of the active channel; • Wetlands – the edge of the temporary zone.
2.3	Identify the water source type	Desktop: Level 3: Sub-system/landscape unit. Site-based: Level 4: Hydromorphic unit.
3	Management objectives	Use appropriate references and methods (below) to formulate management objectives for the watercourse.
3.1	Determine the Present Ecological State	Desktop or site-based assessment depending on requirements from regulating authority.
3.2	Determine the Importance and Sensitivity	To determine the overall importance and sensitivity of a water resource, the ecological, social, and economic importance should be considered.
4	Risk Assessment of water resources	Undertake a risk assessment to assess the potential impacts of planned activities on water resources.
5	Risk Assessment for the protection of biodiversity	Assess risks posed by the proposed development on biodiversity and identify management zones

Step	Task	Scope
6	Delineate and demarcate recommended setback requirements	Finalize and delineate setback requirements on a layout plan and in the field. In doing so, it is also important to ensure that setback requirements also cater to a range of other potentially important management, functional, and legal requirements.
7	Document management measures necessary to maintain the effectiveness of setback areas	Key aspects of the setback requirements will include: • An aquatic impact buffer zone; • Possible core habitat requirements; • Possible corridor requirements; • Any additional aspects requiring consideration to ensure effective management of setback areas.

Data Analysis

The methods and tools that were used as part of the baseline wetland ecosystem assessment are summarised below.

- **Wetland and river /riparian delineation:** 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
- **Classification of Aquatic Ecosystems (rivers & wetlands):** National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis et al., 2013).
- **Present Ecological State (PES):** Level 1 WET-Health assessment (Macfarlane et al., 2020).
- **Functional Importance:** Level 2 WET-EcoServices assessment (Kotze et al., 2020).
- **Ecological Importance & Sensitivity (EIS):** Wetland EIS assessment (Kotze et al., 2020).

Impact Assessment

Impact Categories

Wetland and river ecosystem impacts can be grouped into the following broad impact types:

1. Direct ecosystem modification or destruction / loss impacts – This impact refers to the direct physical destruction and/or modification of wetland communities, habitat and associated biota. Such impacts may be attributed to a range of activities

including vegetation / habitat clearing (stripping / grubbing), earthworks (i.e. excavation and infilling) and deep flooding by impoundments.

2. Alteration of hydrological and geomorphological processes – This impact refers to all the indirect impacts resulting from human activities within the watercourse or catchment that alter hydrological and geomorphological processes i.e. rates of erosion and sedimentation. This includes activities that: (i) modify landcover characteristics that alter the quantity and pattern of catchment runoff and sediment inputs e.g. earthworks, surface hardening, plantations, etc.; (ii) activities that regulate, reduce or increase flows e.g. impoundment / dams, abstraction, return flows and decant flows; and activities alter wetland flow hydraulics e.g. establishment of drains, flow canalisation, flow constrictions and flow diversions.
3. Water pollution impacts – This impact refers to the alteration of the chemical and biological characteristics of soil and water within watercourses and the associated ecological impacts. In the context of this impact assessment, water quality is assessed in relation to changes to its fitness for use (e.g. for domestic, recreational or agricultural purposes) and ability to maintain the health of aquatic ecosystems. This impact includes a full spectrum of activities ranging from direct inputs (e.g. spillages / point source discharges) through to diffuse source inputs from land use activities that affects the quality of water entering watercourses (e.g. hazardous substances handling, storage & transport; urban stormwater management; irrigation return flows and acid mine drainage).
4. Ecological connectivity and edge disturbance impacts – This impact refers to the alteration of local and regional ecological processes resulting from the transformation of land and disturbance within and/or surrounding a watercourse. Key ecological processes of relevance in this regard include ecological connectivity and edge effects edge effects that are impacted by habitat fragmentation, patch size reduction, increased alien invasive plant invasion, noise pollution, vibrations, light pollution, and the occurrence of barriers to propagule and animal movement.

Assessing The Impacts

According to the NEMA regulations (2014), all the impact assessments should provide quantified scores which show the expected impact and those that will likely result from proposed activities. Significance scoring both assesses and predicts the environmental impacts through the evaluation of the following factors;

- probability of the impact,
- duration of the impact,
- extent of the impact, and
- magnitude of the impact.

The significance of those environmental impacts is then assessed by considering any proposed mitigations. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors has been used to assess each potential impact using ranking scales as detailed in Tables 4 and 5 below.

TABLE 4: CRITERIA FOR ASSESSMENT OF IMPACTS.

Severity (Magnitude) The severity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment. The intensity is rated as:	
(I)nsignificant	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
(M)oderate	The affected environment is altered, but functions and processes continue, albeit in a modified way.
(V)ery High	The function or process of the affected environment is disturbed to the extent that it temporarily or permanently ceases.
Duration The lifetime of the impact is measured by the lifetime of the proposed development.	
(T)emporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term	The impact will be relevant through to the end of the construction phase (1.5–2 years).
(M)edium term	The impact will last up to the end of the development phases, where it will be entirely negated.
(L)ong term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial scale Classification of the physical and spatial scale of the impact	
(F)ootprint	The impacted area extends only as far as the activity, such as the footprint occurring within the total site area.
(S)ite	The impact could affect the whole, or a significant portion of, the site.
(R)egional	The impact could affect the area including the neighboring farms, the transport routes, and the adjoining towns.
(N)ational	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Probability This describes the likelihood of the impacts occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
(I)mprobable	The possibility of the impact occurring is none, due either to the circumstances, design, or experience. The chance of this impact occurring is zero (0 %).
(P)ossible	The possibility of the impact occurring is very low, due either to the circumstances, design, or experience. The chance of this impact occurring is defined as 25%.
(L)ikely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chance of this impact occurring is defined as 50%.
(H)ighly Likely	It is most likely that the impacts will occur at some stage of development. Plans must be drawn up before carrying out the activity. The chance of this impact occurring is defined as 75%.
(D)efinite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

TABLE 5: SIGNIFICANCE SCORING USED FOR EACH POTENTIAL IMPACT.

PROBABILITY	***DURATION***

1-very improbable *2-improbable* *3-probable* *4-high probable* *5-definite*	*1- very short duration (0-1years)* *2- short duration (2-5 years)* *3- medium term (5-15 years)* *4- long term (>15 years)* *5- permanent/unknown*
EXTENT	***MAGNITUDE***
1- Limited to the site *2- Limited to the local area* *3-Limited to the region* *4-National* *5-International*	*2- minor* *4- low* *6-moderate* *8-high* *10-very high*

The following formula was used to calculate impact significance:

Impact Significance: (Magnitude + Duration + Extent) x Probability)

The formula gives a maximum value of 100 points which are translated into 1 of 3 impact significance categories; Low, Moderate, and High as per Table 6 below.

TABLE 6: IMPACT SIGNIFICANCE RATINGS.

SIGNIFICANCE POINTS	SIGNIFICANCE RATING
0 - 30 points	Low environmental significance
31 - 59 points	Moderate environmental significance
60 -100 points	High environmental significance

Details of the significance of the various impacts identified are presented in Tables 8 and 9.

Determination of Significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Significance Rating (SR) = (Extent + Intensity + Duration) x Probability

<u>Identifying the Potential Impacts without Mitigation Measures (WOM)</u>

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (before the implementation of mitigation measures). Significance without mitigation is rated on the following scale (Table 7):

TABLE 7: SIGNIFICANCE RATING SCALES WITHOUT MITIGATION

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could influence the decision unless it is mitigated. An impact or benefit which has important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	The impact is significant, mitigation is critical in reducing the impact or risk. The resulting impact could influence the decision depending on the possible mitigation. An impact that could influence the decision about whether or not to proceed with the project.

Identifying the Potential Impacts with Mitigation Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact, after the implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale, Table 8.

TABLE 8: SIGNIFICANCE RATING SCALES WITH MITIGATION.

SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < SR < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures to reduce the negative impacts to acceptable levels, the negative impact will remain significant. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance after mitigation could render the entire development option or entire project proposal unacceptable.

Baseline Assessment

The wetlands likely to be impacted were identified using the 'likelihood of impact' guidelines in Table 9.

TABLE 9: QUALITATIVE 'LIKELIHOOD OF IMPACT' RATINGS AND DESCRIPTIONS.

Likelihood of Impact Rating	Description of Rating Guidelines

Definite	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within the footprint of the proposed development activity and will be impacted by the project; and/or ➢ ➢ resources located within 15m upstream and/or upslope of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ ➢ resources located within 15m or downslope of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: o within 15m downstream of a low-risk development; o within 50m downstream of a moderate risk development; and/or o within 100m downstream of a high-risk development e.g. mining, large industrial land uses.
Likely / Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within 32m but greater than 15m upstream, upslope, or downslope of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation, and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: o within 32m downstream of a low-risk development; o within 100m downstream of a moderate-risk development; and/or o within 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams/abstraction and treatment plants).
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope, or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation, and erosion). This is generally resources located downstream within the following parameters: o greater than 32m downstream of a low-risk development; o greater than 100m downstream of a moderate-risk development; and/or o greater than 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams/abstraction and treatment plants).

None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment, and which will not be impacted by the development in any way, shape, or form.

Results

Assessment results

The study area is characterized by depressions and quarries which are all artificial wetlands that have resulted from long term mining and disturbance. There is also an unchanneled-valley bottom wetland which traverse the site on the eastern direction. The photos below show some of the assessed quarries.

PRESENT ECOLOGICAL STATUS (PES)

The PES of the wetland system identified in the area is **Moderate, with a PES score of 4-5, Category D,** Table 10. This implies that the system has been largely modified.

A large change in ecosystem processes and lo ss of natural habitat and biota has occurred, but some remaining natural habitat features (water and vegetation) are still recognizable with the local ecological role provided. Some of the attributes used to guide and assess the wetland's integrity, are indicated on Table 11 below.

TABLE 10: HEALTH CATEGORIES USED BY WET-HEALTH FOR DESCRIBING THE INTEGRITY OF WETLANDS (MACFARLANE *ET AL*, 2007).

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	0.0.9	A	Very High
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B	High
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C	Moderate
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D	Moderate
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E	Low
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.10	F	Very Low

TABLE 11: HABITAT INTEGRITY ASSESSMENT CRITERIA FOR WETLANDS (DICKENS, *ET AL*, 2003; DWAF, 1999) SUCH AS ADAPTED FROM KLEYNHANS (1996).

Criteria & Attributes	Relevance
Hydrologic	
Flow Modification	A consequence of abstraction, regulation by impoundments, or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, and velocity affect the inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent Inundation	A consequence of impoundment destroying the natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements, and industrial activities. Aggravated by the volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Reduction due to entrapment by dams or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or changes to inundation patterns of wetlands and thus changes in habitats. River diversions or drainage.

Criteria & Attributes	Relevance
Topographic Alteration	A consequence of infilling, plowing, dykes, trampling, bridges, roads, railway lines, and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Desiccation of wetlands and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing, or firewood collection affects wildlife habitat and flow attenuation functions, organic matter inputs, and increases the potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Overuse of Biota	Overgrazing, overfishing, etc.

Scoring guidelines per attribute:

natural, unmodified = 5;

Largely natural = 4,

Moderately modified = 3;

Largely modified = 2; - Category D*; largely modified, largely loss of natural habitat and basic ecosystem function has occured*

seriously modified = 1;

Critically modified = 0.

Relative confidence of score:

Very high confidence = 4;

High confidence = 3;

Moderate confidence = 2;

Marginal/low confidence = 1.

Ecological Importance and Sensitivity (EIS)

This section indicates the results of the Ecological Importance and Sensitivity (EIS) assessment. Also, the Ecological Importance (EI) which is the expression of how important the wetland is, in terms of its maintenance of biological diversity and ecological functioning at a local/regional and landscape level, (Kotze *et al*., 2020) was determined. Ecological Sensitivity refers to the ecosystem's fragility or the ability to resist or recover from a disturbance, (Kotze *et al*., 2020).

The wetland system was assessed as being **Moderate** (*Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small* *role in moderating the quantity and quality of water in major rivers, DWAF, 1999*) for Ecological Importance and Sensitivity (EIS) driven by the current impacts and conditions on the local footprint, Table 12.

These impacts are a result of mining, urbanization and other human activities in the area. Transformation of the areas has led to the introduction of invasive alien plants. The natural integrity of the wetland system for ecological importance is compromised and impacted severely.

In this regard, there is a great possibility of sedimentation into the system, to some certain extent. The study suggests that the wetland system is not highly sensitive to the proposed application and current activities, considering that all activities shall be taken in areas that are already modified. The importance of the wetland system is at the regional level and contributes to the local preservation of main birds and other small aquatic biotas.

TABLE 12: ENVIRONMENTAL IMPORTANCE AND SENSITIVITY RATING SCALE USED FOR THE ESTIMATION OF EIS SCORES (DWAF, 1999).

Ecological Importance and Sensitivity Categories	Rating
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1

Ecosystem Services: Wetland Functional Assessment

This section discusses the results of the wetland ecosystem service assessments. Ecosystem services are broadly defined as the benefits people obtain from ecosystems (Kotze et al., 2020). A broader definition is that they are all the aspects of ecosystems utilized (actively or passively) to produce human well-being (Kotze et al., 2020).

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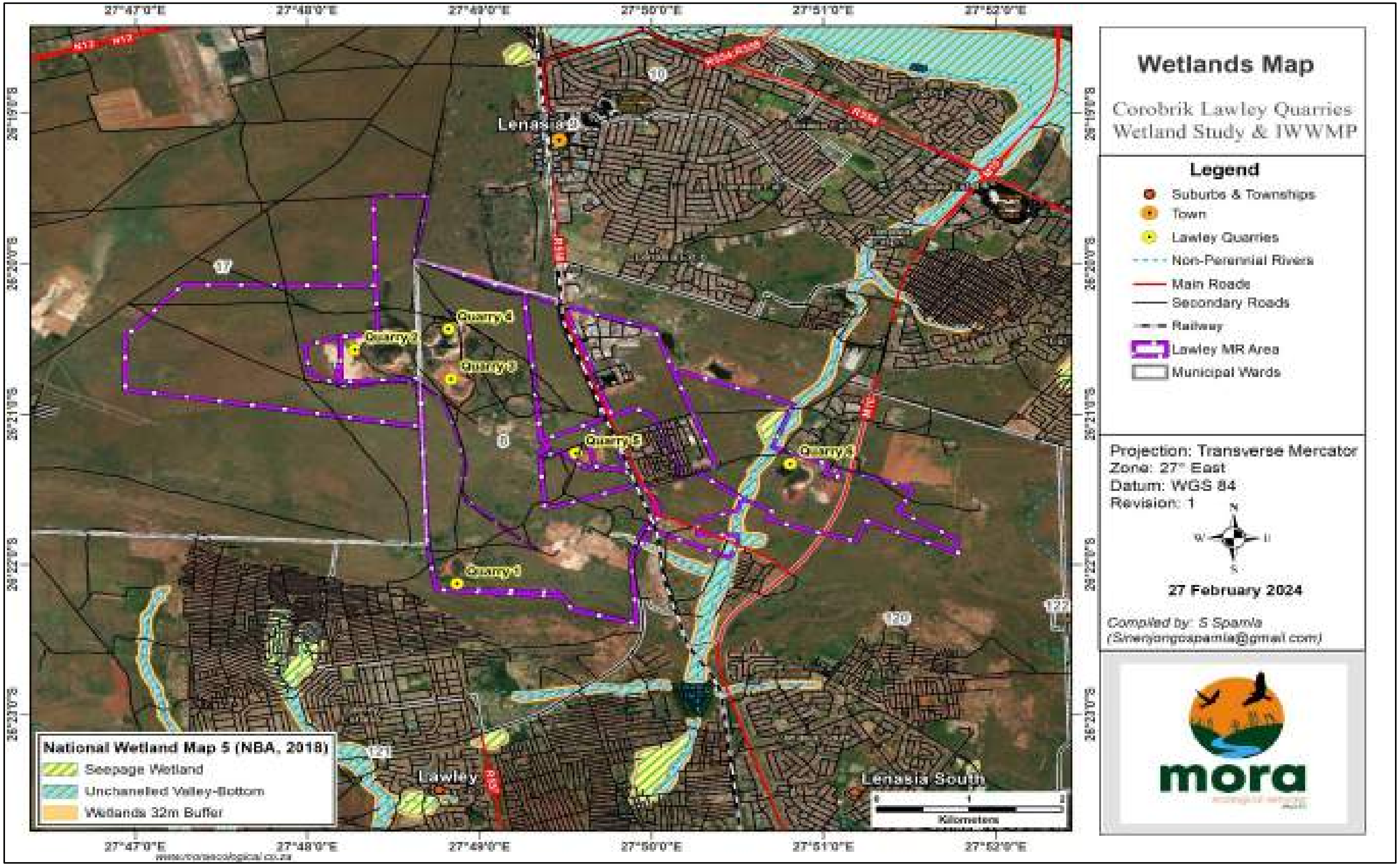


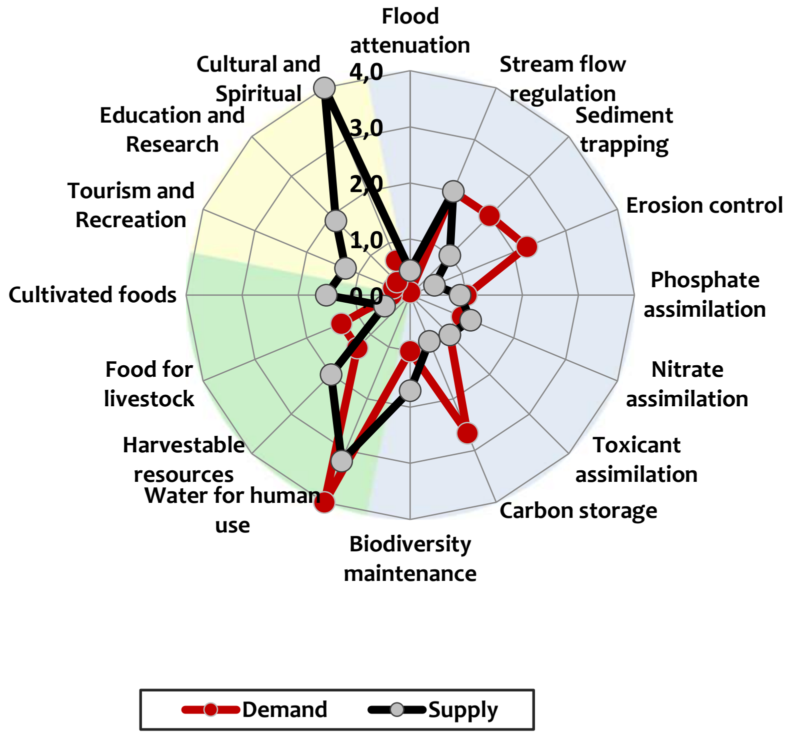
FIGURE 5: DELINEATED WATERBODIES.

Table 13: Ecosystem services importance scores and ratings for the depression wetlands

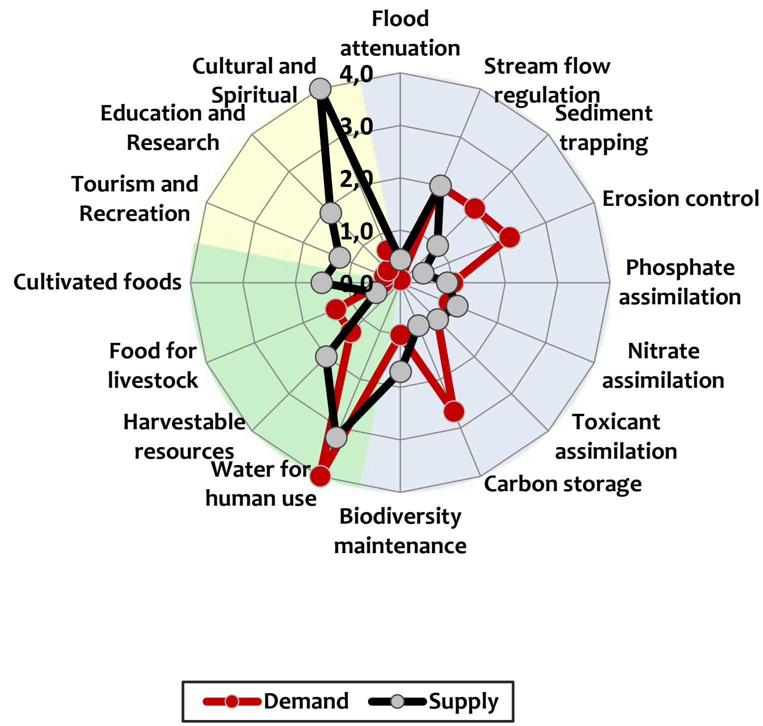
		UVB				UVB			
		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,4	0,1	0,0	Very Low	0,4	0,1	0,0	Very Low
	Stream flow regulation	2,0	2,0	1,5	Moderately Low	2,0	2,0	1,5	Moderately Low
	Sediment trapping	1,0	2,0	0,5	Very Low	1,0	2,0	0,5	Very Low
	Erosion control	0,5	2,3	0,1	Very Low	0,5	2,3	0,1	Very Low
	Phosphate assimilation	0,9	1,0	0,0	Very Low	0,9	1,0	0,0	Very Low
	Nitrate assimilation	1,2	1,0	0,2	Very Low	1,2	1,0	0,2	Very Low
	Toxicant assimilation	1,0	1,0	0,0	Very Low	1,0	1,0	0,0	Very Low
	Carbon storage	0,9	2,7	0,7	Very Low	0,9	2,7	0,7	Very Low
	Biodiversity maintenance	1,7	1,0	0,7	Very Low	1,7	1,0	0,7	Very Low
PROVISIONING SERVICES	Water for human use	3,2	4,0	3,7	Very High	3,2	4,0	3,7	Very High
	Harvestable resources	2,0	1,3	1,2	Low	2,0	1,3	1,2	Low
	Food for livestock	0,5	1,3	0,0	Very Low	0,5	1,3	0,0	Very Low
	Cultivated foods	1,5	0,3	0,2	Very Low	1,5	0,3	0,2	Very Low
CULTURAL SERVICES	Tourism and Recreation	1,3	0,3	0,0	Very Low	1,3	0,3	0,0	Very Low

	Education and Research	1,9	0,3	0,5	Very Low	1,9	0,3	0,5	Very Low
	Cultural and Spiritual	4,0	0,7	2,8	High	4,0	0,7	2,8	High

Present State Assessment



Future State Assessment



Recommended Ecological Category (REC)

The recommended ecological category (REC) is the target or desired state of freshwater ecosystems required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES that is driven by the context / setting. The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the watercourse (Kleynhans & Louw, 2007). However, the causes related to a PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs for water resources is shown in Table 14, below.

Table 14: Generic matrix for the determination of REC for water resources.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Improve

Based on the above matrix (Table 14), the PES of the system is below REC and as such PES should ideally be improved (Table 15). It is thus important that no severe negative residual impacts occur as a result of the mining activities. Any direct and indirect negative impacts as a result of the mining activities would be undesirable from a water resource management perspective and therefore the management objective must be to ensure that the project impacts are mitigated such that the current supply of ecosystem services remains the same or better.

Table 15: REC and RMO for the wetland units based on their PES and EIS ratings.

Watercourse Unit(s)	PES	EIS	REC	RMO
	F	Low	F	Improve

Water Quality Assessment

According to the South African Quality Guideline, water quality describes the physical, chemical, biological, and aesthetic properties of water which determine its fitness for a variety of uses and for protecting the health and integrity of aquatic ecosystems. Many of these properties are controlled or influenced by constituents which are either dissolved or suspended in water.

The following water quality variables were recorded in situ.

pH: At pH less than 7 water is acidic, while at pH greater than 7 water is alkaline.

The geology and geochemistry of the rocks and soils of a particular catchment area affect the pH and alkalinity of the water. The pH of most raw waters lies in the range of 6.5 - 8.5. Biological and anthropogenic activities such as nutrient cycling and industrial effluent discharge respectively can give rise to pH fluctuations. Notably, acid mine drainage can have a marked effect on the pH. Further, acid-forming substances, such as oxides of sulphur and nitrogen released into the atmosphere may ultimately alter the acid-base equilibria in natural waters and result in a reduced acid-neutralizing capacity and hence lowering the pH.

Electrical conductivity (EC): is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence of ions in water such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge. Most organic compounds dissolved in water do not dissociate into ions, consequently they do not affect the EC.

Total Dissolved Solids: represents the total concentration of dissolved substances in water. TDS is made up of inorganic salts, as well as a small amount of organic matter. Common inorganic salts that can be found in water include calcium, magnesium, potassium and sodium, which are all cations, and carbonates, nitrates, bicarbonates, chlorides and sulfates, which are all anions. Cations are positively charged ions and anions are negatively charged ions.

Dissolved Oxygen: The maintenance of adequate dissolved oxygen (DO) is critical for the functioning of aquatic ecosystems since it is required for the respiration of all aerobic organisms (DWAF, 1996). Therefore, DO concentration provides a useful measure of the health of an ecosystem (DWAF, 1996). The median guideline for DO for the protection of aquatic biota is > 5 mg/l (Kempster et al., 1980). The low oxygen availability will have a limiting effect on aquatic biodiversity.

Based on the Target Water Quality Guidelines as set out by the Department of Water and Forestry (DWAF) now the Department of Water and Sanitation (DWS) for aquatic ecosystems (DWAF, 1996).

No water quality sampling was conducted due to no flowing steam present.

Recommended Mitigation Measures

This section outlines the mitigation measures recommended to avoid, reduce / minimise, and rehabilitate the freshwater ecosystem impacts discussed in previous sections that follows this section.

'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on freshwater ecosystems is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected.

1.1. Project Planning and Design Measures

Application of the Mitigation Hierarchy

The mitigation hierarchy is a framework to enable environmental considerations to be incorporated meaningfully into the development planning process (Figure 6). This is achieved by chronologically applying four principles in a stepwise manner, namely: 1. Avoid, 2. Minimise, 3. Rehabilitate, and 4. Offset, as outlined in Figure 6. The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can best be accommodated without incurring significant negative impacts to the receiving environment.

The protection of water resources (wetlands & rivers/streams) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces such impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging.

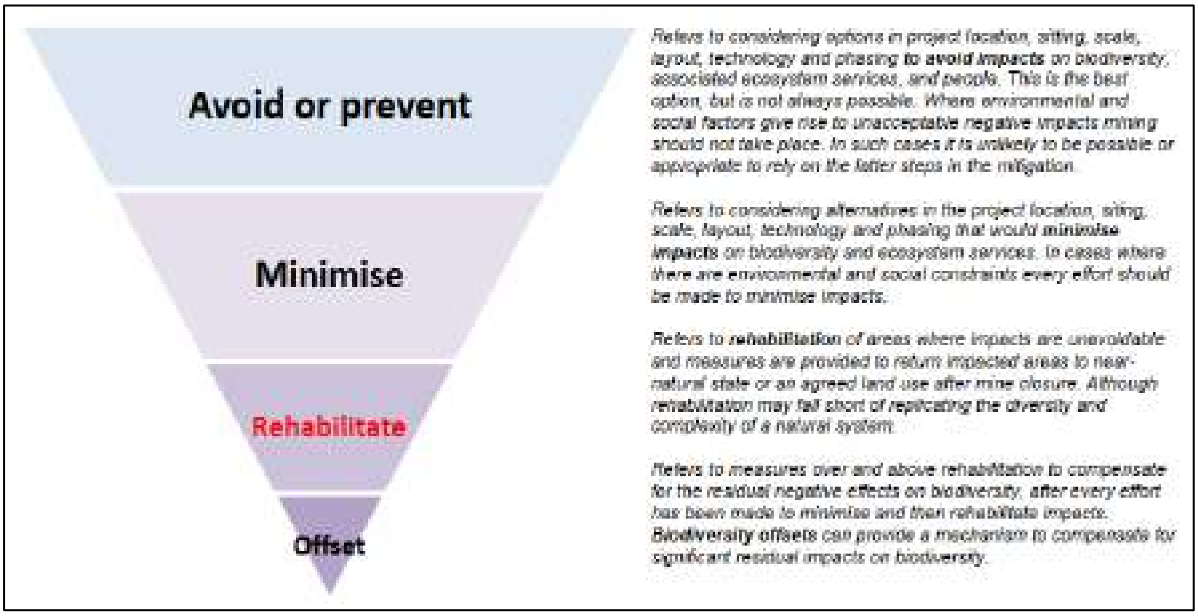


FIGURE 6: DIAGRAM ILLUSTRATING THE 'MITIGATION HIERARCHY.

In this regard, we assume that wetland disturbance, modification, and infilling in the vicinity of the present road embankments is inevitable as the road embankments will be extended into the wetland both upstream and downstream of their present locations.

To assist with guiding this process, following planning measures are listed in chronological order of investigation in line with the mitigation hierarchy:

Step 1: Avoidance:

- Investigate road design alternatives that increase road width to the required extent but avoid further wetland encroachment by the fill embankments.
- All stormwater outlets must be located outside of wetlands.

Step 2: Minimisation:

- Where avoidance of direct and indirect impacts cannot be achieved for well-substantiated reasons, the following measures must be investigated:
    - Where stormwater outlets are located within the watercourse/wetlands the footprint of such structures must be minimised as far as practically possible and erosion protection must be installed below all outlets to ensure that erosion and sedimentation impacts are minimised.

Step 3: Remediation:

- Direct and indirect impacts to watercourse because of planned and approved encroachment / working in wetlands must be rehabilitated.

- Indirect erosion and sedimentation impacts to wetlands during operational phases must be rehabilitated.
- Any accidental wetland encroachment and loss during the mine operational phases should be rehabilitated.

Step 4: Offset:

- Not applicable to this project provided that all efforts to minimise the extent of wetland loss are investigated and applied.

The above-mentioned measures are further expanded on in the sections that follow.

The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

<u>Demarcation of 'No-Go' areas and construction corridors</u>

- All areas outside of the approved and licensed mining footprint must be considered no-go areas for the entire construction phase. Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- The demarcation work must be signed off by the Environmental Officer (EO) before any work commences.
- The demarcations are to remain until mining and rehabilitation is complete.

<u>Method Statements for working in watercourses.</u>

Detailed method statements must be developed for all activities planned within the wetlands.

<u>Runoff, erosion and sediment control</u>

- Wherever possible, existing vegetation cover on the development site should be maintained during the mining phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Sediment barriers (e.g.: silt fences/sandbags/hay bales) must be installed immediately downstream / downslope of active work areas (including soil stockpiles) as necessary to trap any excessive sediments generated during construction.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales,

sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2m) to break the energy of surface flows. Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.

- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.
- Regular maintenance of all runoff, erosion and sediment control measures must be undertaken during the construction / establishment period to ensure that these structures continue to function appropriately.

<u>Hazardous substances / materials management</u>

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 30m of the watercourse.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such purpose.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.

<u>Noise, dust and light pollution minimisation</u>

- Temporary noise pollution due to daily works should be minimized by ensuring the proper maintenance of equipment and vehicles and tuning of engines and mufflers as well as employing low noise equipment where possible.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This will likely be required daily in the drier months or during dry periods.

- No lights must be established within the construction area near the watercourses and buffer zones.

General rehabilitation guidelines

- All disturbed areas beyond the mining site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.
- All land impacted by the mining activities must be rehabilitated by undertaking the following general tasks: o All foreign material must be removed from site.

o Land must be regraded / re-shaped and topsoils must be reinstated.

o Compacted soils must be adequately ripped/loosened where compacted, as informed by the ECO.

o Re-vegetation should take place as follows: ▪ For any permanently and seasonally saturated areas - via translocation / transplanting of rescued sods and, where there are not enough rescued sods, via the translocation / transplanting of sods from the surrounding wetland as advised a wetland ecologist.

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Operational Phase

<u>Maintenance and management</u>

- It is important that the location and extent of the wetlands in the vicinity of project activities be incorporated into all formal maintenance plans for the mining lifespan.
- In terms of management, alien invasive plant control must be practiced on an on-going basis in line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on their property.

Monitoring

It will be important that long-term monitoring of the potential wetland ecosystem impacts be undertaken proactively to identity any environmental issues and impacts that may arise as a result of the operational phase of the project. The following key aspects should be monitored:

- Erosion and/or sedimentation in the onsite and downstream wetlands;
- Presence of alien invasive plants; and
- Water quality and evidence of pollution.

Remediation / Rehabilitation

Where appreciable direct vegetation/habitat impacts, water quality impacts (i.e. due to spills) or erosion/sedimentation impacts resulting from stormwater management failures, these must be reported immediately to the relevant environmental authorities, and an independent aquatic / wetland specialist appointed to conduct a site inspection to assess the residual impacts and determine the need for any onsite remediation or rehabilitation requirements. Following this assessment, an implementable remediation and/or wetland rehabilitation plan may need to be compiled and implemented to the satisfaction of Department of Mineral Resources and Energy and Department of Water and Sanitation.

Impact and Risk Assessment

This section deals with the assessment of the operational phase impacts of the project on local wetland ecosystems.

Activities and Impacts Assessed

The activities requiring assessment for this study and the associated potential impacts are summarised in Table 16, on the next page.

Key Assumptions

The following assumptions apply to the impact assessment:

- The realistic good mitigation scenario assumes the following:

  All the planning and design measures recommended previously will be adhered to. If any of the recommended mitigation measures provided cannot be adhered to, the impact and risk assessments will need to be revised.

Table 16: Summary of impacts assessed for each of the project activities.

Project Phasing & Activities	**Impact Group**	**Impact Description**
C1.Construction activities: Clearing of vegetation, stripping / grubbing of soil, earthworks, infilling.	C1-1: Direct ecosystem destruction and modification impacts	• Accidental direct impacts to the watercourse and vegetation by heavy machinery and/or fill material during construction.
	C1-2: Indirect hydrological and geomorphological impacts	• Erosion and/or sedimentation of watercourse/wetland due to catchment and/or wetland soil and vegetation clearing and landcover disturbance during construction. Erosion impacts like gully formation of channel incision and widening will further confine flows and reduce soil saturation in the rooting zone, thus resulting in changes to vegetation composition. • Increased sedimentation of wetlands. Sedimentation impacts will result in the smothering and possibly burial of wetland vegetation and reduced near-surface soil saturation rates also resulting in changes to vegetation composition. • Temporary flow diversion and reduced water inputs to certain areas during the construction phase.
	C1-3: Water quality impacts	• Pollution of water due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction (e.g. oil and diesel leaks and spills). • Any erosion leading to sedimentation of watercourse onsite/downstream could also lead to raised water turbidity and suspended solids concentrations, also affecting water quality. • Accidental damage and/or rupture to existing sewer, gas, oil and fuel pipes during construction activities along the road and/or within the wetland.
	C1-4: Fragmentation and ecological disturbance impacts	• Modified ecological connectivity. • Expanded / more intense edge impacts could result in the deterioration in vegetation quality and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities in and near watercourse.

		• Noise pollution and vibrations associated with earthworks and the use of heavy machinery could affect local wildlife (birds, amphibians and small mammals especially).
Project Phasing & Activities	**Impact Group**	**Impact Description**
O1: Operational activities: Mining/quarrying, stormwater management, internal roads maintenance	O1-1: Direct ecosystem destruction and modification impacts	• Accidental direct impacts to wetland and wetland/buffer vegetation by heavy machinery during infrastructure repair and maintenance activities.
	O1-2: Indirect hydrological and geomorphological impacts	• Erosion and/or sedimentation of watercourse as a result of increased stormwater runoff discharges from the surrounding slopes. • Erosion impacts like gully formation of channel incision and widening will further confine flows and reduce soil saturation in the rooting zone, thus resulting in changes to vegetation composition. • Sedimentation impacts will result in the smothering vegetation and reduced near-surface soil saturation rates also resulting in changes to vegetation composition.
	O1-3: Water quality impacts	• Pollution of onsite and downstream rivers due to the mishandling of hazardous substances and/or improper maintenance of machinery during repair and maintenance activities (e.g. oil and diesel leaks). • Any erosion leading to sedimentation could also lead to raised water turbidity and suspended solids concentrations, also affecting water quality.
	O1-4: Fragmentation and ecological disturbance impacts	• Modified ecological connectivity. • Expanded / more intense edge impacts as a result of vegetation clearance, could result in the deterioration in vegetation quality and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities taking place near watercourse.

Impact Significance Assessment

The impact significance assessment ratings for all eight (8) impacts under poor and good mitigation scenarios is summarised in Table 17 below.

The moderate significance ratings for both impacts are driven by the risk of hydrocarbon spillages that may occur in the vicinity of the project activities, and which would result in a substantial hazardous spill into the wetland systems.

The impact of the direct loss of water resources as a result of the approved mining activities was assessed as being of moderately-low significance under a poor and good mitigation scenario. this is because the area to be impacted will be relatively small and because the loss will have a small impact on the overall PES and provision / supply of ecosystem services.

The remaining impacts were all assessed as being of low to moderately-low significance under a poor mitigation scenario and of low significance under a good mitigation scenario.

Table 17: Summary of the wetland impact significance assessment under ‘poor’ and ‘good’ mitigation scenarios.

Phase	Impacts	Intensity	Extent	Duration	Probability	Significance
‘Poor’ Mitigation Scenario						
Construction	C1-1: Direct ecosystem destruction and modification impacts	Moderate	Surrounding Area	Permanent	Definite	Moderately Low
	C1-2: Indirect hydrological and geomorphological impacts	Moderate	Local	Long-term	Highly Probable	Moderately Low
	C1-3: Water quality impacts	High	Local	Medium-term	Probable	Moderate
	C1-4: Fragmentation and ecological disturbance impacts	Low	Surrounding Area	Short-term	Definite	Low
Operation	O1-1: Direct ecosystem destruction and modification impacts	Moderate	Surrounding Area	Long-term	Probable	Moderately Low
	O1-2: Indirect hydrological and geomorphological impacts	Low	Surrounding Area	Long-term	Definite	Low
	O1-3: Water quality impacts	High	Local	Long-term	Possible	Moderate
	O1-4: Fragmentation and ecological disturbance impacts	Low	Surrounding Area	Long-term	Unlikely	Low
‘Good’ Mitigation Scenario						
Construction	C1-1: Direct ecosystem destruction and modification impacts	Moderate	Surrounding Area	Permanent	Definite	Moderately Low
	C1-2: Indirect hydrological and geomorphological impacts	Moderately-low	Surrounding Area	Medium-term	Probable	Low
	C1-3: Water quality impacts	Low	Site	Short-term	Possible	Low
	C1-4: Fragmentation and ecological disturbance impacts	Low	Surrounding Area	Short-term	Definite	Low
Operation	O1-1: Direct ecosystem destruction and modification impacts	Low	Site	Long-term	Possible	Low
	O1-2: Indirect hydrological and geomorphological impacts	Low	Surrounding Area	Long-term	Probable	Low
	O1-3: Water quality impacts	Low	Local	Long-term	Possible	Low
	O1-4: Fragmentation and ecological disturbance impacts	Low	Surrounding Area	Long-term	Unlikely	Low

DWS Risk Matrix Assessment

The DWS risk matrix assessment scores and ratings for all eight (8) impacts under the good mitigation scenario only is summarised in Table 18 below.

Under a good mitigation scenario, impacts C1-1 and C1-2 were assessed as being of moderate risk. This is because Impact C1-1 will involve the infilling of watercourse and Impact C1-2 will involve high impact activities stripping, grubbing earthworks within and near wetlands, as well as the potential for temporary flow diversion. It is important to note however that the risk scores are all within 25 points of the low risk category, indicating that these risks can be considered borderline cases. It is also important to note that a very small impact to the PES and functionality / EIS of the larger river system is predicted with no drop in PES class. The rest of the impacts were all assessed as being of low risk under a good mitigation scenario.

Table 18: Summary of the DWS 'Risk Assessment Matrix' results under a 'good' mitigation scenario.

Phase(s)	Activity	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geology & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
Construction	Construction PHASE (C) Clearing of vegetation, stripping / grubbing of soil, earthworks, infill, establishment (construction)of road infrastructure.	C1: Direct ecosystem destruction and modification impacts	1	1	2	1	**1.25**	1	2	**4.25**	5	5	5	1	**16**	**68**	**Moderate**
		C2: Direct hydrological and geomorphological impacts	1	1	1	1	**1**	2	2	**5**	3	3	5	2	**13**	**65**	**Moderate**
		C3: Water quality impacts	1	1	1	1	**1**	1	1	**3**	3	2	5	2	**12**	**36**	**Low**
		C4: Fragmentation and ecological disturbance impacts	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**
Operation	OPERATIONAL PHASE (O) stormwater management,culvert maintenance and repair, monitoring.	O1: Direct ecosystem destruction and modification impacts	1	1	1	1	**1**	1	2	**4**	2	2	5	1	**10**	**40**	**Low**
		O2: Indirect hydrological and geomorphological impacts	1	1	1	1	**1**	1	2	**4**	3	3	5	2	**13**	**52**	**Low**
		O3: Water quality impacts	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**
		O4: Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**

Assumptions, Limitations & Level of Confidence

The following limitations and assumptions apply to this assessment:

- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These areas were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- Although every effort was made to correctly identify the plant species encountered onsite, wetland plants, particularly the Cyperaceae (sedge) family, are notoriously difficult to identify to species level. Every effort as made to accurately identify plants species but where identification to species level could not be determined, such species were only identified to genus level.
- Seasonality can also influence the species of flora encountered at the site, with the flowering time of many species often posing a challenge in species identification. Since some marginal areas of wetland vegetation in the study area was found to be largely secondary/degraded with low native plant diversity, seasonality would not be as significant a limitation when compared with a vegetation community that is largely natural or high in native plant diversity.
- The assessment of impacts is predictive and was based on the information and site development provided by the client. The 'realistic good mitigation scenario' impact significance ratings and assessment outcomes assumes that all the mitigation measures recommended in previous section will be adhered to.

Conclusion

This assessment has confirmed that the majority of the waterbodies observed on a desktop level are quarries resulted from on-going mining activities. There is only one unchanneled-valley bottom wetland occurring along the eastern boundary. A number of operational phase mitigation measures have been provided in this report to effectively minimise the potential impacts of the mining activities.

In terms of impact significance, the moderate significance ratings for both impacts are driven by the risk of hydrocarbon spillages that may occur in the vicinity of the project activities, and which would result in a substantial hazardous spill into the watercourse. This impact can be reduced to low significance through appropriate consideration of the habitat sensitivity and site conditions.

The impact of the direct loss of wetland as a result of the approved mining activities was assessed as being of moderately-low significance under a poor and good mitigation scenario. This is because the area to be impacted will be relatively small and because the loss will have a small impact on the overall wetland PES and provision / supply of ecosystem services.

The remaining impacts were all assessed as being of low to moderately-low significance under a poor mitigation scenario and of low significance under a good mitigation scenario.

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ANNEXURE A

Project	Corobrik Lawley		
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Name	Mokgatla Molepo		
Registration	Pr.Sci.Nat.	**SACNASP Registration No.**	009509

				Severity														
Phase(s)	**Activity**	**Aspects**	**Impact**	**Flow Regime**	**Physico & chemical (water Quality)**	**Habitat (Geomorph & Vegetation)**	**Biota**	Severity	**Spatial Scale**	**Duration**	**Consequence**	**Frequency of Activity**	**Frequency of Impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**
Construction	CONSTRUCTION PHASE (C) Clearing of vegetation, stripping / grubbing ofsoil, earthworks, infill, establishment (construction) of road infrastructure.	Clearing of vegetation, stripping and grubbing of soil, earthworks, excavations, infilling	C1: Direct ecosystem destruction and modification impacts	1	1	2	1	**1.25**	1	2	**4.25**	5	5	5	1	**16**	**68**	**Moderate**
		Exposure of bare, sandy soilsto the elements, following	C2: Direct hydrological and geomorphological impacts	1	1	1	1	**1**	2	2	**5**	3	3	5	2	**13**	**65**	**Moderate**
		vegetation clearing and bulk excavations																

		Management of fuels/chemicals, potential spills from vehicles, equipment and containers, damage to pipelines	C3: Water quality impacts	1	1	1	1	**1**	1	1	**3**	3	2	5	2	**12**	**36**	**Low**
		Earthworks, clearing and disturbance of vegetation and human activitiesin the vicinity of wetland habitats	C4: Fragmentationand ecological disturbance impacts	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**
Operation	OPERATIONAL PHASE (O) Stormwater management, culvert maintenance and repair, monitoring.	Clearing of vegetation, stripping and grubbing of soil, earthworks, excavations, infilling during repair and maintenance	O1: Direct ecosystem destruction and modification impacts	1	1	1	1	**1**	1	2	**4**	2	2	5	1	**10**	**40**	**Low**
		Road storm water managementand flow alteration byculverts	O2: Indirect hydrological and geomorphological impacts	1	1	1	1	**1**	1	2	**4**	3	3	5	2	**13**	**52**	**Low**
		Road stormwater contaminants, damage to pipelines during repair and maintenance	O3: Water quality impacts	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**
		Expanded/more intense edge	O4: Impacts to ecological	1	1	1	1	**1**	1	1	**3**	2	2	5	2	**11**	**33**	**Low**